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CLARION MERLAN M10

INTRODUCTION

The Clarion MerLAN M10 is a wireless transceiver providing 10 Megabits/sec burst data rate to support wireless connections in IEEE 802.3 and Ethernet II LANs. The MerLAN M10 functions as an Ethernet Medium Attachment Unit (MAU). The Medium Access Control (MAC) frame from a standard Attachment Unit Interface (AUI) port is encapsulated to form a Radio Frequency (RF) MAC frame. It uses the state-of-the-art spread spectrum technology to implement robust 10Mbps burst transmission. It also manages the efficient utilization of frame buffers and coordination of the RF and wired interface traffic to maintain this high throughput. In addition, the unit offers true "Plug and Play" installation; no additional driver software is required for its operation. That is, the MerLAN M10 can be connected to not only a computer, but also to router. In certain configurations and topologies, the unit can also be connected directly to a bridge or hub. Accordingly, you can create various kinds of innovative LANs combining existing wired devices and the Clarion MerLAN M10 units.

PRODUCT OVERVIEW

The Clarion MerLAN M10 is a combination of hardware and firmware providing 10 Mbps data rate over a wirless medium using state of the art direct sequence spread spectrum radio technology in the 2.4 GHz radio frequency band. Utilizing forward error correction, re-transmission protocol, flow control, and continuously changing spreading codes, the MerLAN M10 provides a fast, safe, secure, and robust wireless transmission. A Windows 3.1 based configuration utility program enables the MerLAN M10 to be fine tuned to integrate seamlessly into your existing network environment preserving your current resource investment. The configuration options provide network connectivity directly to personal computers, routers, bridges, and hubs.

DATA TRANSFERS

A data transfer is called an **Upload** when the ethernet device conveys a frame from itself to the MerLAN M10's buffered memory through the MAU port. The buffered memory is organized as 16 2K byte FIFOs with each

FIFO being independently employed and capable of storing a maximum length ethernet frame of 1518 bytes. Eight buffers are used to hold ethernet frames received via the wireless medium and eight buffers are used to hold ethernet frames received from the wired medium. On an Upload when all eight buffers are used, a collision signal is generated to force the ethernet card into its exponential back-off algorithm for flow control. If generation of the collision is not selected via the configuration process, then no collision is generated and the Upload is ignored. On an Upload, the MerLAN M10 provides the following:

- Detection of the preamble of the ethernet frame followed by the frame sync pattern
- Suppression of the ethernet preamble and frame sync for RF transmission since these portions are meaningless for wireless transmission
- Generation of a collision signal if an upload commences and there is no buffer available
- Forward Error Correction encoding of the data when that option is enabled through the configuration process
- Generation of the header information for the RF MAC and RF physical layer
- Spread spectrum carrier sense before transmission with preference given to reception
- Data and spread spectrum modulation onto a carrier of 2.4 GHz and RF transmission

A data transfer is called a **Download** when the MerLAN M10 conveys a frame from its buffered memory through the MAU port to the ethernet device. On a Download, the MerLAN M10 provides the following:

- Detection of and time alignment to the received radio signal
- Demodulation of the physical header and MAC frame
- Forward Error Correction decoding when the unit recognizes that the received frame is FEC encoded by reading the physical header
- Checking the 32-bit CRC generated by the ethernet card which uploaded the frame
- conversion of the serial stream to bytes for storing in the buffered memory FIFO

- Regeneration of the ethernet preamble and frame sync
- Detection of any collision condition for avoiding collision of the download to the upload and signaling of such to the AUI interface and to the CPU.

M10 CONTRASTED WITH WIRED-MEDIUM

The industry way of transmitting and receiving data over Clarion's MerLAN M10 (and many other) networks cause data packets to be frequently lost or links to be limited to only point-to-point (i.e., only 2 radios per cell). This is due to the fact that a wireless network does not have the ability to properly detect collisions like an Ethernet network has. In an Ethernet network collisions can be detected by the hardware (Ethernet chip) and are immediately re-transmitted. Ethernet is referred to as CSMA/CD (Carrier Sense Multiple Access with Collision Detect). Wireless networks are referred to as CSMA/CA (Carrier Sense Multiple Access with Collision Avoidance). The reason that collisions cannot be detected is because with a radio cannot receive and transmit at the same time, hence collisions cannot be detected.

While the M10 has been designed to appear electrically as a standard MAU, it is executing a medium-access protocol appropriate for the wireless medium. As a result, certain of its behaviors are not reflected in a wired-medium MAU, and the transparency to the wired-medium MAC in the attached computer or bridging device cannot be absolute. MAUs for wired networks have no internal storage; they operate with negligible delay relative to the signals at the AUI/MAU interface. Because the MAC software in the attached computer is executing a protocol appropriate for the wired medium, and the M10 must employ a protocol appropriate for the wireless medium, the M10 stores frames in buffers in order to isolate the (wired and wireless) media. This results in important differences from conventional 802.3 MAUs; these include buffer delay as well as the need for RF retransmissions and for flow control.

BUFFER DELAY

The protocol operating over a MerLAN M10 link has an inherent delay of two frames in each direction. When a frame is offered from the AUI port, it is first saved in a buffer. Subsequently, the frame is transferred over the RF channel to a receive buffer in the destination MerLAN M10. Only then is the frame downloaded to the destination AUI port. This need not limit throughput if the transport protocol properly anticipates the delay. If the protocol waits for each frame to be acknowledged, then the throughput achieved will be very low due to the excess delay inherent in the buffering process. However, if a burst mode is used, then the effect of the delay can be made negligible.

RF RE-TRANSMISSION PROTOCOL

RF signals transmitted from the M10 are not simultaneous with the corresponding AUI activity. Although there are MAC-level retransmissions in wired networks when a collision is sensed, the buffering of frames in the M10, added to the fact that failure of an RF transmission cannot be sensed at the transmitter, means that the wired-side MAC cannot provide retransmissions. Thus, in order to avoid long delays for retransmission by the level-four Transport protocol, e.g., TCP or IPX, the use of RF-MAC-level retransmissions is important for high throughput.

The re-transmission protocol at the RF MAC layer provides enhanced reliability. The 32 bit CRC, checked by the 802.3 MAC layer to provide the final data reliability, is also used to support re-transmission protocol. The use of the RF MAC level re-transmission protocol, recommended by the 802.11 draft standard, is important for high throughput. Re-transmission via the level four transport protocol must be avoided, if at all possible, because of the long time-out typically employed. Prior to the re-transmission, the MerLAN M10 recognizes and memorizes the source MAC address of an ethernet device connected to the unit through the MAU port. The download occurs only when the MerLAN M10 recognizes complete matching of the memorized source MAC address and destination MAC address written in a received radio frame. Once the MerLAN M10 memorizes the source MAC address, no update of the source MAC address is performed in the unit unless power is turned off. This means that applications that lead to frequent change of the source MAC address of the ethernet frame coming from multiple ethernet devices through the MAU interface are not suitable for making the re-transmission protocol effective. In the case of such applications, it is recommended that the MerLAN M10 be configured without the re-transmission option.

The re-transmission protocol is based upon the recognition of acknowledgments generated by a MerLAN M10 unit that received a radio data frame from another unit. A radio frame that carries the acknowledgment is called an ACK frame which only affects the RF MAC level protocol. The contents of the ACK frame never appears at the MAU port. The ACK frame is transmitted immediately after the completion of receiving the radio frame. The re-transmission protocol is not available for Broadcast frames (destination ethernet address of all 1 bits) because no ACK frame can be transmitted for those type of frames.

There are two different causes that will result in the re-transmission of radio frames. One is the missing of an ACK frame and the other is a missing data frame. In either case, the sending MerLAN M10 recognizes that there was no return of the ACK frame from the receiving MerLAN M10 within the allotted time-out period, therefore, the sending unit initiates the re-transmission of the radio frame. In the case of a missing ACK frame, the radio frame being re-transmitted is recognized by the receiving unit as a duplicate frame and filters it out, such that the download of the frame does not occur. This is called the Duplicate Filter function. The Duplicate Filter is only functional when a single ethernet device is connected to the MerLAN M10. This function will be updated in the future to make it available for

multiple ethernet devices. Duplicate frames that the MerLAN M10 does not filter out will be removed by a function of the Network Operating System. The maximum number of re-transmissions is seven (eight transmissions total) after which the data is dropped and the successful transmission will depend upon another re-transmission provided by the Network Operating System protocol. The value of the ACK frame time-out is currently fixed at 300 micro seconds. It will be updated to a user definable time through the configuration process in the future to support various ranges of wireless link distances.

FLOW CONTROL

When no buffers are available for an Upload of AUI frames to the MerLAN M10, the unit will take one of two separate courses depending upon the option selected during the configuration process. The first course of action, which is also the default, is for the unit to invoke flow control by using the collision signal to force the ethernet card into its exponential back-off algorithm. Because there are eight upload buffers, this flow control can always maximize the RF throughput even though the attached device may delay re-offering frames. The second course of action, which is an option that can be chosen during the configuration process, is to ignore upload frames when no upload buffer is available. This may be required when the MerLAN M10 is connected to multiple computers (e.g., via a hub) which might be disrupted by excessive collision indications. However, ignored frames will incur a large delay for retransmission by the level-4 transport protocol (TCP, SPX), or may not be re-offered at all for datagrams (UDP, IPX). Although using the collision signal for flow control is the default, the user must make an informed selection between the two possibilities based upon network topology, acceptable link behavior, and the requirements of the application software.

SECURITY

Since secure data is a great concern with any wireless transmission system, the MerLAN M10 offers excellent security without using conventional cryptography. The security of the data transmissions is achieved by continuously changing and pseudo-randomly selecting spreading codes. The user may select from 2^{16} (64K) different sequences to determine the order in which the spreading codes are used. This provides excellent security against eavesdropping by unintended parties. The actual sequences can be selected through the configuration process provided by the MerLAN M10 configuration software.

ANTENNA RECOGNITION

The FCC prohibits standard types of antenna connectors for systems such as the MerLAN M10. Although the unit uses a standard SMA female connector for the external antenna port, the FCC has allowed this standard connection for the MerLAN M10 because of the special antenna recognition function provided by the unit. This function is implemented in an electrical manner instead of a mechanical manner. Accordingly, no antennas or antenna systems except those that Clarion provides as genuine accessories for the MerLAN M10 are available. If such antennas or antenna systems are connected to the MerLAN M10, the unit will never transmit. The external antenna port outputs a low DC voltage (up to +5 Volts) for this recognition. The unit is unconditionally safe against any type of passive load connected to the external antenna port.

WARNING: If any measuring equipment is connected to the external antenna port, please check that the allowed DC voltage applied to the input of the equipment can be accommodated without any damage to the equipment.

NOTE: Transmit signals can not be observed by connecting the external antenna port to any measuring equipment because of the antenna recognition function described above. A measuring antenna together with an approved Clarion antenna can be used for any such requirement.

SPECIFICATIONS

The following figure represents the current specifications for the Clarion MerLAN M10 unit.

Frequency Range:	2.416 - 2.456 GHz ISM band
Carrier Frequency	2.436 Ghz
Modulation Technique:	Spread Spectrum - BPSK, 32 Mcps
Output Power:	25 mW (14 dBm)
Receive Sensitivity	-86 dBm
Data Rate:	10 Mbit/sec.
Media Access Protocol:	Ethernet Variety (CSMA/CA)
Power Consumption (TX):	1.6 - 2.0 Amp
Power Consumption (RX):	1.1 - 2.0 Amp
Power Requirements	6.2VDC (min 6.0, max 6.85)
Power Supply (Input)	100-125VAC
Power Supply (Output)	6.2VDC 2A
Operating Temperature	0° - 40° C
FCC Regulations:	No site license required

Figure 1 MerLAN M10 Specifications

CONNECTIVITY

The MerLAN M10 can be directly connected to several types of LAN devices by means of the MAU port on the unit. It can be connected directly to personal computers, routers, bridges, and hubs by means of the AUI port on those devices. A standard AUI cable can be connected to the MerLAN M10 and any of these units via their AUI port. A more detailed description of these connections follows. The main concern is how the MerLAN M10 is configured when attached to these various devices.

PERSONAL COMPUTERS

The MerLAN M10 can be connected directly to the AUI port of a network adapter card of a personal computer by using a standard AUI cable. If the network adapter card in the PC has a 10Base-T connection, that connection can be used to connect to the MerLAN M10 by means of an AUI to 10Base-T media converter that also crosses over the send and receive data signals. The default configuration parameters should be used when the MerLAN M10 is connected to a personal computer.

ROUTERS

All routers normally support an AUI port which can be used to connect the MerLAN M10 unit via a standard AUI cable. Connecting the MerLAN M10 to routers presents no inherent problems even though many workstations can be transmitting packets to the routers. A router encapsulates the original ethernet message with a new ethernet destination (another router) and itself as the source address and sends the message directly to another router thereby presenting only a single ethernet source address to the MerLAN M10 which it adopts and can use for acknowledgments for the re-transmission protocol. The default configuration parameters should be used when the MerLAN M10 is connected to a router.

BRIDGES AND HUBS

Connecting the MerLAN M10 directly to a bridge or hub can also be done by means of a standard AUI cable. If there are only 10Base-T connections on the hub, a 10Base-T to AUI media converter can be used. The physical connection of a bridge or hub to the MerLAN M10 is not a problem, but this scenario presents a situation that can impact performance issues based upon the actual communication topology trying to be supported. Remember that the MerLAN M10 derives its RF address from the first ethernet message it receives from the MAU connection and that address is used to generate and validate acknowledgments. Since there are several devices generally connected to a bridge or hub, the source address in the ethernet messages is constantly changing creating a problem for the MerLAN M10 in the generation and validation of acknowledgments. In these particular cases, please read Supported Network Configurations later in this document to determine how the MerLAN M10 should be configured for your site's particular network topology.

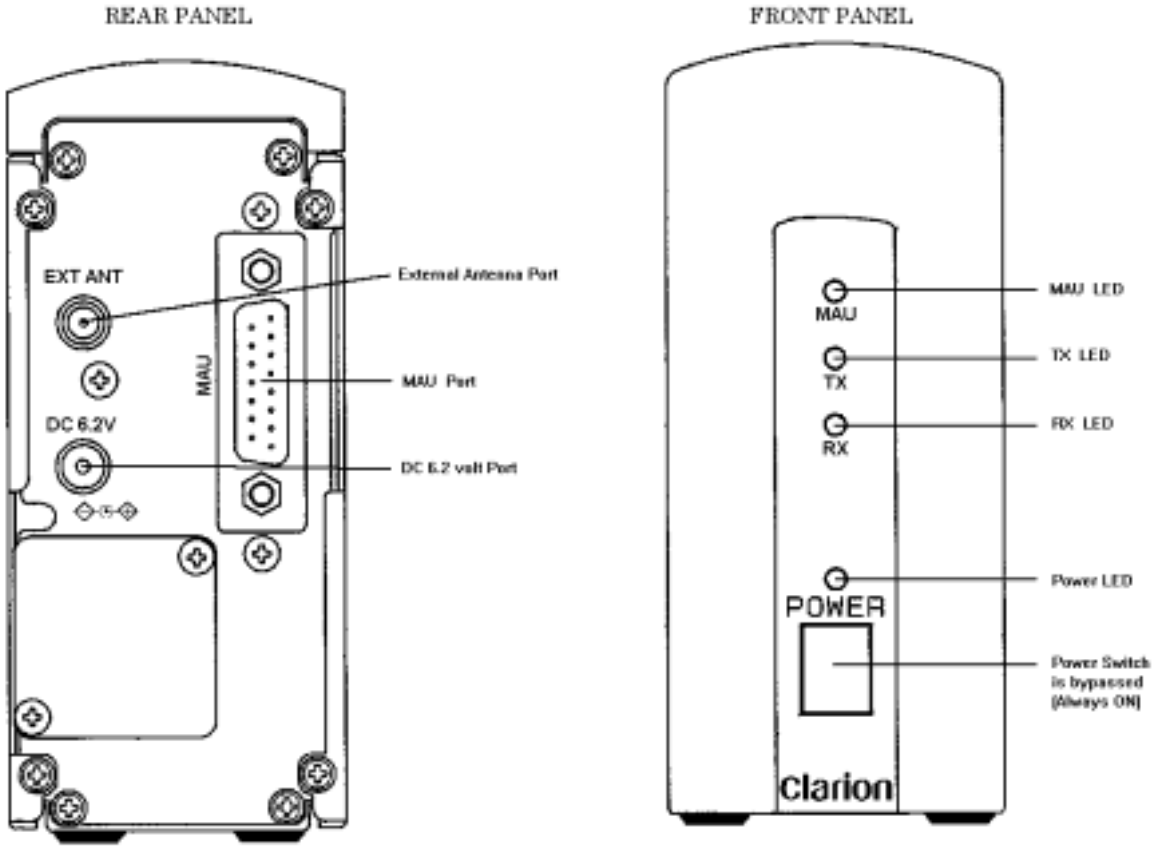

Figure 2 MerLAN M10 Front and Rear Panel

MANAGER/CONFIGURATION UTILITY

The MerLAN M10 Manager/Configuration Utility program is used to manage any number of M10s and also to set various configuration options if any of the Merlan M10 default settings are not the ones desired. This utility was designed to be installed and run as a Microsoft Windows 3.1 application program.

INSTALLATION

To install the MerLAN M10 Manager/Configuration utility, perform the following steps:

1. Insert the Installation disk 1 into Drive A: or B:
2. Click “FILE” and then “RUN” from the Windows Program Manager
3. Click “BROWSE”, select Drive A: or B: and click on “SETUP”
4. Click “OK” to run the Setup program for the Configuration Utility
5. Follow any instructions indicated by the Setup program

The Installation program will perform the following functions:

1. Copy the Visual Basic run-time library into the appropriate directories
2. Copy the MerLAN M10 configuration software into the directory C:\M10
3. Create the MerLAN M10 program group and program icons

To uninstall the MerLAN M10 Configuration Utility

1. Delete the directory C:\M10 using the Windows File Manager
2. Delete the M10 Program group or the M10 Icon if it was copied or moved to another group
3. **DO NOT** attempt to delete the run-time modules. They will not cause any problem and they may be required by some other application

M10 MANAGER

The M10 Manager is designed to handle any number of M10s, all of which must be reachable from this computer’s 802 LAN, e.g., via any collection of

hubs, repeaters, and bridges. The M10 Manager cannot reach any M10 unit that is not reachable through a completely wired connection. This means that M10 units which are only reachable via a wireless connection from this computer cannot be managed from this computer. The M10 Manager does not directly read the configurations of M10s under its control. A database is stored on the disk. This information is accessed by selecting a particular M10 from the dropdown list of the M10 Manager dialog box. The user may add a new M10, modify the description of an M10, remove an M10 or configure an M10. Any changes are saved to disk to keep the database current. If configuration frames are required, the frame data is saved to disk, then a DOS utility is called to actually send the frame.

Adding a New M10

When the New button is clicked, the Add New M10 dialog box appears. The text description starts with time/date information, for example, M10 added on 9/30/96 10:08:44 AM. This can be edited, and the description entered can be up to 1000 characters in length. If many M10s are to be managed, then the description should be detailed enough to avoid confusion. If more than a single M10 is to be controlled, then the user is advised to set the M10 Address. The M10 Manager will allow only a single unit to use the Clarion Null address at any time. Thus, if some M10 is identified as, or configured via the Clarion Null address, no new units can be added.

An RF Address can be entered; if so, this RF Address is stored in non-volatile memory. A full 12-hex-digit address must be entered for the RF Address. If, however, the M10 Address is being copied/pasted to the RF Address, then selecting the six least-significant digits automatically includes the other six. Deleting the RF Address text unassigns the RF Address.

If no RF Address is entered, the unit will learn its RF Address upon each power-up cycle. Click Cancel or Done as appropriate to cancel the entry or to complete the operation.

Modifying the Description of an M10

When the Modify button is clicked, the Change RF Address & Description dialog box appears. The text can be edited, and the description can be up to 1000 characters in length. If many M10s are to be managed, then the description should be detailed enough to avoid confusion.

If more than a single M10 is to be controlled, then the user must set the M10 Address. The M10 Manager will allow only a single unit to use the Clarion Null address at any time. Thus, if some M10 is identified as, or configured via the Clarion Null address, no new units can be added.

An RF Address can be entered; if so, this RF Address is stored in non-volatile memory. A full 12-hex-digit address must be entered for the RF Address. If, however, the M10 Address is being copied/pasted to the RF Address, then

selecting the six least-significant digits automatically includes the other six. Deleting the RF Address text unassigns the RF Address.

If no RF Address is entered, the unit will learn its RF Address upon each power-up cycle.

Click Cancel or Done as appropriate to cancel the entry or to complete the operation.

Removing an M10

When the Remove button is clicked, a message box will display "Are you sure you want to remove .....". Click OK to remove the unit, or Cancel to cancel the operation. Clicking the OK button is final.

Configuring an M10

Clicking the Configure button brings up the M10 Configuration dialog box for that unit. The parameters and values shown are those reflected in the current data base for the currently selected unit.

The AUI Parameters, Code Channel, and Search Code are configured directly from this dialog box, while the Retransmission Protocol and Channel-Access Protocol may be configured by bringing up the appropriate dialog box using the corresponding Set button.

The Default button sets **all** parameters back to the factory default settings. When the Done button is clicked, the updated information is saved in the M10 Manager data base, and any required configuration frames are issued.

CONFIGURATION PARAMETERS

The configuration parameters are explained in this section. Each description includes the permissible values that can be entered for the parameter enclosed within braces, the default setting of the parameter, and a brief explanation of the functionality of the parameter.

Spreading Code Selection

Code Channel {four hex digits} default = 2D1B. This is a four-hex-digit pattern which specifies the sequence of spreading codes used for the data portion of the frame transmission. This is a security measure. Any two M10s must use the same Code Channel in order to exchange data. Enter by editing as text.

Search Code {0,1,2,3,4,5,6,7} default = 0. There are eight Search Codes available. These do not provide security, rather they can be selected to provide isolation between independent M10s operating in close proximity. Operation of different Search Codes simply avoids the transmissions of one link from triggering detections on the other link. Select via a dropdown list.

Channel Access Protocol

On Ethernet both carrier sensing and collision detection are simple processes. For any radio channel the ability to detect collisions is lost; in addition, for a spread-spectrum system with changing codes (for security) the ability to perform carrier sensing is limited to acquisition of the preamble portion of a transmission. The channel-access protocol (CAP) employed in the M10 is called P-persistent CSMA.

When an M10 has scheduled a transmission, the start time of that transmission is selected randomly from a grid of P possible start times, these being separated by the slot time. The slot time is somewhat larger than the one-way propagation time; this ensures that if only one transmission is started at a slot boundary, then all other M10s can detect that transmission and cancel any other pending transmissions. Of course, there remains the probability 1/P that any two radios might select the same slot boundary on which to transmit, and then the two transmission will collide. In dense environments selecting a large value for P keeps the network from collapsing, while in less-dense environments a small P gives higher throughput. With P as a configurable parameter (in fact, dynamically configurable) the M10 supports a variety of user-controlled CAP strategies.

The M10 provides for adaptive P-CSMA by using a sequence of P values. These are loosely tied to the transmission attempts in that the P values in the sequence correspond to the attempt number, but any successful receive resets to P0 for the next attempt. If that attempt fails, the sequence of P values is resumed according to which attempt is in progress. (P is a power of two, up to 256.)

P0,...,P7 Default: 4,8,16,32,64,128,256,256. One of three buttons may be set:

Exponential causes each P to be double the previous in the sequence; this is modeled after exponential backoff of Ethernet. The user sets only P0.

Constant causes only the P0 value to be used, i.e., non-adaptive. The user sets only P0.

Custom enables the user to select any arbitrary adaptation strategy.

Retransmission Protocol

The retransmission protocol is key to high throughput in any radio LAN. Without retransmissions at the MAC layer, any lost frame would incur the relatively large time-out of the layer-4 (Transport layer) reliability protocol before a missed frame is sent again. The M10 retransmission protocol has a window of 1 such that it focuses its effort on the delivery of a single frame for up to eight (8) transmission attempts, and must either succeed or fail on that frame before moving to the next available (buffered) frame. When retransmissions are enabled, a transmitting M10 marks its transmitted frame as requiring an ACK, transmits the frame, then after the transmission is completed waits for an ACK. If after waiting for ACK_timeout time and no

ACK has been received, then another transmission is scheduled. If an ACK is received on any attempt, then the M10 moves to the next available frame awaiting transmission. On the last transmission attempt, the transmitting M10 does not ask for the ACK; rather it moves immediately to the next frame.

Check Address {On/Off} default = Off. RF Address comparison for sending ACKs and receiving ACKs. Click to toggle. See Supported Network Configurations later in this document for a further explanation of RF address checking.

The following retransmission parameters are activated by selecting the Set button:

Transmission Tries {1,2,3,4,5,6,7,8} default = 8. Retransmission (ReTx) protocol offers up to 8 total tries (7 retries) for lost frames. Enable each try (after the first) by changing its dropdown-list selection from "off" to "on" (in no-diversity mode), or from "off" to either "same" or "toggle" (in diversity mode). Note: this also selects the diversity antenna sequence; the first try option selects either the internal or external antenna, or diversity mode.

FEC {1,2,3,4,5,6,7,8,no FEC} default = 2. Use Forward Error Correction to overcome channel errors when the probability of a successful frame transfer is too low to clean up with the retransmission protocol alone. Click the button next to the attempt on which the FEC should be activated (can not be set to any Retry that is set to Off), or click No FEC.

Antenna Selection Diversity {Int,Ext,Div} default = Ext. The dropdown list selections for the first transmission attempt are: **Int** which uses the Internal Antenna Only; **Ext** which uses the External Antenna Only; **Div** which turns on the Diversity function meaning that either antenna can be used depending upon the option selected in the Retry choices. The **Retry 1** through **Retry 7** drop down choices depend upon the selection chosen for the first transmission attempt. If *Ext* or *Int* is the first transmission attempt selection, then the Retry choices are only On or Off and once Off is selected for a Retry, then the following Retry choices are automatically set Off. If *Div* is the first transmission attempt selection, then the Retry choices are Off, Same, or Toggle and once Off is selected for a Retry, then the following Retry choices are automatically set Off.

AUI Parameters

Send SQE Test {On/Off} default = Off. This is a collision pulse issued after an UPLOAD for checking the collision cable pair. It is the same SQE test as is implemented in any Ethernet card. (IEEE 802.3 Standard section 7.2.2.2.4).

Collisions for Busy {On/Off} default = On. When all upload buffers are full, then no more frames can be accepted from the AUI port. If collisions for

busy is *Off*, then frames offered at the AUI port will be ignored, and the level-4 transport protocol is responsible for re-initiating the frame transfer for each such ignored frame; this will result in large delays due to the level-four-transport time-out delay. If Collisions for busy is *On*, then the M10 will send a collision indication for flow control via the Ethernet back-off algorithm. When such collisions can be used, the (MAC-level) delay for re-initiating a frame transfer will be small.

Filter Duplicates {On/Off} default = On. There will always be some non-zero rate of lost frames over any RF link; some of these lost frames inevitably will be ACKs in response to received frames. When this happens, the retransmission protocol will cause some duplicated frames at the receiver. If filter duplicates is enabled, this option will inhibit the download of a frame if its sequence number matches the most-recently downloaded frame.

Download Error Frames {On/Off} default = Off. Sends frames failing CRC to the AUI port anyway. This option is for diagnostic use only.

SUPPORTED NETWORK CONFIGURATIONS

The use of the MAC-level retransmission protocol combined with the single RF Address for an M10 limits the configurations supported. The variations considered are whether the retransmission protocol is used, and, if so, whether the RF Address is checked for ACKing. The three possible combinations, each with an explanation of the network topology supported, are as follows:

Retransmit Off

Any network configuration can be used, e.g., multiple M10s, each possibly connected to multiple Ethernet cards via 10baseT hubs, in a peer-to-peer network. No RF Address assignment is required, or relevant. The importance of MAC-level retranmissions because of the unavoidable loss of RF frames makes this network less attractive in practice than those supported by having retransmissions on.

Retransmit On, Address Check Off

Any point-to-point connection of a pair of M10s can be used, e.g., interbuilding bridging or routing, wireless connection of two 10baseT hubs, etc. Because there can be only one receiving M10 at any instance, there is no need for the RF Address. Care must be taken that the pair of M10s is on a distinct code channel.

Retransmit On, Address Check On

In this case, an RF Address must be assigned to each M10. There are numerous possibilities, depending upon how the RF Address is selected.

1. Multiple M10s, each connected via a single Ethernet card to a computer, in a peer-to-peer wireless network. Each M10 should learn or be configured with the attached Ethernet Card's 802 address to be used for its RF Address. This network behaves (logically) as though the network cards are connected by wire.

2. Multiple M10s, each connected via a single Ethernet card to a router, in a multi-point wireless inter-network configuration. Each M10 should be configured with the attached Ethernet Card's address used for its RF Address. M10s should be placed on local router ports, rather than WAN ports, which are restricted in data rate.

3. Multiple M10s, each connected via a single Ethernet card to a bridge, in a multi-point wireless bridging configuration. Each M10 should be configured with its M10 Address as its RF Address. The bridges must have address bindings between the various Ethernet cards and M10s, and the source and destination addresses must correspond to the M10s on either end; (wired-side) frames would, of course, be encapsulated within the frame delivered to the M10 by the bridge. The topology appears very similar to that of #2 (the router configuration), but M10 Addresses must be used.

4. Multiple M10s each possibly connected to multiple Ethernet cards (e.g., via 10baseT hubs), in a peer-to-peer network with RF Addresses assigned for only selected card addresses (one per M10). For example, by assigning the address of a server to the M10's RF Address it is possible to operate the RF-MAC-level retransmission protocol for the server traffic, leaving only lower-priority peer-to-peer traffic somewhat disadvantaged.

In #2 and #3 above, note that a router is a peer correspondent on each network to which it is connected, while the bridge is a peer on none of the networks. That is, a router is a source and destination on a network, using its Ethernet card's unique 802 address; while the bridge uses its Ethernet card's 802 address only for network control, but for normal traffic it uses the original source address and the end destination address.

M10 USE OF 802 ADDRESSES

From the wired side, frames are uploaded to and downloaded from the M10 at the AUI Port (AUI connector is attached, mating MAU connector is on the M10). From the RF side, frames are transmitted from and received into the RF Port. The destination address of each received RF frame is checked, if

address checking is enabled, to determine whether an ACK is required (or was received). The destination address of each uploaded AUI frame is checked to determine if the frame was intended to be used to configure the M10.

M10 Address

Each M10 is assigned a unique 48-bit IEEE 802 address at the factory in a similar manner to any Ethernet card. The number serves the purpose of uniquely labeling the M10 within network address space, and it also doubles as a manufacturing serial number.

Config Address

An M10 can be configured to recognize management data as frames addressed to the Clarion NULL address (00606F000000) if there is only a single M10; for M10s to which configuration frames can be routed via a wired network, the M10 must be set to accept only management frames specifically addressed to the M10 via its specific M10 Address.

RF Address

The retransmission protocol uses an acknowledgment (ACK) sent from the receiving M10 to the transmitting M10 to indicate that the frame transmission was successful. Each M10 uses an RF Address which is compared to the destination address of a received frame to determine that the frame was intended for that M10, hence that it should send an ACK if the frame was received intact. An M10 awaiting an ACK compares the destination address of the ACK it receives to its RF Address. No filtering of traffic is performed by the M10; the RF Address is used only to operate the retransmission protocol. The M10 should use as its RF Address the address of a device attached to the AUI port. The RF Address can be designated by user configuration; otherwise it is learned by the M10 from the first frame offered to the M10 after power-up. Power-up learning of the RF Address is consistent with M10 attachment to a single Ethernet card. Configuring the M10 to retain a specific RF Address for traffic purposes is required, for example, when the M10 is attached to a network traffic source/sink and also to a network-monitoring device whose address might be unintentionally learned during power-up. When designated by user configuration, the M10 could have its RF Address set to its unique M10 Address. This supports bridging, where the attached bridge has binding address information sufficient to direct frames to specific M10s.

FIRMWARE UPGRADE

In the event that new MerLAN M10 firmware is released and needs to be installed, you will receive a floppy disc with the necessary programs and files

to perform the upgrade. The upgrade software uses Novell's IPX/SPX protocol and will run under DOS or as a DOS program under Windows 3.1. Of course, the PC must have a network interface card (NIC) installed with an AUI and/or a 10BaseT port. If the NIC does not have an AUI port, then a 10BaseT to AUI converter must be used, such as a hub with both types of connections or an AUI to 10BaseT media converter. If the MerLAN M10 is to be directly attached to the NIC with an AUI port, then an AUI transceiver cable can be used to make the connection. If the MerLAN M10 is to be directly attached to the NIC with a 10BaseT port, then an AUI to 10BaseT media converter must be used which can crossover the send and receive signals. There is no problem if a hub is used as the media converter. Finally, the standard Clarion Power Supply accessory for the MerLAN M10 must also be used to power the unit.

INSTALLATION

The following steps should be taken to install the upgrade software:

1. Prepare your PC to execute a DOS program.

2. Insert the floppy disc labelled “M10 UPGRADE” into a floppy disc drive.

3. Type **A:** or **B:** to change to the floppy disc drive where the disc was inserted.

4. Type **INSTALL <drive>** where <drive> is a letter of a hard disc drive of the PC (usually **C:**). The install procedure automatically creates a new directory called M10UG on the selected hard drive and extracts the upgrade programs and files into it.

UPGRADE PROCEDURE

The upgrade procedure requires that the MerLAN M10 unit be connected directly to the NIC on the PC via an AUI cable, or 10BaseT cable with an AUI to 10BaseT media converter which crosses the send and receive data signals, or thru a hub. Perform the following steps to upgrade the MerLAN M10.

1. Connect the Clarion Power Supply to the M10. Wait for the blinking of the red TX LED to stop before trying to run the upgrade program.

2. Type **UPGRADE <xxxxxx>** where <xxxxxx> is the last six digits of the serial number of the M10 unit which is written on the label attached to the bottom of the unit or is the Clarion NULL address of six zeroes. The first six digits are always 00606F. If the unit is configured to use the Clarion NULL address, then type **UPGRADE 000000** . If the unit is not configured to use the NULL address and if the serial number is 00606F040417, then type **UPGRADE 040147**. You will see the following messages displayed:

```
**********************
*
* M10 Uploader v2.7
*
**********************
Initializing IPX...
Canceling pending events...
Getting network address...
Setting target address...
Getting local node...
Uploading...
Frame: 24/24, 024840 bytes...
```

NOTE: The frame number begins at 01/24 and increases up to 24/24 during which the red TX LED begins blinking twice at approximately 2 second intervals. The completion of the firmware transmission is indicated by the red TX LED remaining on and the following messages being displayed.

```
Transfer complete
Wait for boot LED or AUI boot message (apox. 4 mins)
Hit any key to exit.
04:17
```

At this time, the MerLAN M10 starts burning the EEPROM and the red TX LED remains on and blinks approximately every 20 seconds. The AUI cable may be disconnected at this time to be used to connect another M10 for upgrade purposes but the power cable must remain connected throughout the burning process which takes approximately 4.5 minutes after which the red TX LED goes off.